A subject-based aspect report on provision in Scotland's colleges by HM Inspectors on behalf of the Scottish Funding Council

Computing
16 October 2009

Scottish Funding Council
Promoting further and higher education

HMIe
improving Scottish education
leasachadh foghlam na h-Alba

Contents

1 Introduction and methodology

The HMIE publication, *External quality arrangements for Scotland's colleges*[1], specifies that HMIE will produce a number of subject aspect reports over the four years 2008-12. These aspect reports complement in a subject-specific context the generic evaluations of learning and teaching in HMIE's reports of external review of colleges. Colleges should act on the recommendations contained in these reports and college inspectors will monitor action towards implementation of these recommendations as part of their normal dialogue with colleges and will wish to discuss issues arising from subject aspect reports during annual engagement visits.

In preparing this report, inspectors visited a sample of ten colleges, drew on the findings of published HMIE reviews of colleges, and examined other relevant publications and reports. They consulted with key stakeholders, including The Scottish Qualifications Authority (SQA), college practitioners, and Scotland's Colleges.

Each college in the sample of ten was visited twice during the fieldwork. In a number of colleges, areas for development identified by inspectors during the first visit had been addressed by curriculum managers by the time of the second visit. An example of this quality improvement is in one college where, during the first visit, inspectors noted insufficient use by teaching staff of effective questioning techniques to confirm learners' understanding before moving on to the next topic. By the time of the second visit to the college, teaching staff had addressed this issue, with a resulting improvement in the quality of learners' experiences. A second example can be found in another college where, as a result of the first visit to the college, a weakness was found in relation to the vocational expertise and knowledge of current industry practice of teaching staff. At the time of the second visit, the college had addressed and resolved this issue. A list of colleges visited for the report may be found in the Appendix.

This aspect report identifies important areas for discussion and debate and evaluates current practice. It identifies excellent practice where HM Inspectors have found it and sets out areas for development.

[1] HMIE, September 2008

2 Background and context

Computing education in Scotland's colleges currently faces a number of significant challenges. Numbers of learners enrolling on computing programmes in Scotland's colleges have been falling. Learning and teaching on computing programmes in colleges has considerable room for improvement. Of the 26 reviews of Computing and ICT carried out by HMIE between September 2004 and June 2008, only five colleges (19%) received a grade of *very good* for learning and teaching process, against a national average of all subjects of 46%. Retention of learners and their attainment of qualifications are generally low. In learner progress and outcomes, only one college (4%) was evaluated as *very good*, against a national average of 29%. Eleven colleges (42%) received a grade of *fair* for this element. The national average for *fair* across all subject areas was 13%.

There has been a serious shortage of applicants for computing courses in higher education institutions (HEIs). Many institutions report a 50% drop in applications over the last five years, placing at risk the viability of many undergraduate courses in computing and related subjects. The recent economic downturn has boosted applications for places in almost all subjects in Scotland's colleges but this effect may lessen as economic activity begins to improve. There is no nationally-collated data available on the number of applications for places on computing programmes.

In the college sector, serious debate has begun in order to identify the causes of the drop in applications for computing programmes and the poor retention and attainment of those who study computing programmes. This debate has involved Scotland's Colleges, SQA and HMIE. A majority of those contributing to this debate agree that there are fundamental issues to be addressed in relation to programme design and learning and teaching approaches. Much remains to be done to improve learning and teaching, but the direction of travel is positive. Recent SQA initiatives in new course structures at further education (FE) level are making a helpful contribution to improving FE programme design in colleges.

The recently-published computing science contexts for developing technological skills and knowledge within the technologies framework of *Curriculum for Excellence* provide a solid foundation in schools for the study of computing topics and an effective preparation for further study at senior level in secondary schools, in colleges and in HEIs. The experiences and outcomes build on the particular contribution that computing science can make to a broad education.

Examples include:

> *By learning the basic principles of a programming language or control technology, I can design a solution to a scenario, implement it and evaluate its success (TCH 4-09a)*
>
> *I can build a digital solution which includes some aspects of multimedia to communicate information to others (TCH 3-08b)*

Provision that falls within the scope of this report includes programmes at all levels of the Scottish Credit and Qualifications Framework (SCQF)[2] delivered in Scotland's colleges that lead to qualifications designed to meet the needs of the computing industry as defined by *e-Skills UK*[3], the sector skills council (SSC) for business and information technology. Provision designed to develop general ICT skills, such as the European Computer Driving Licence and PC Passport do not fall within the scope of this report.

[2] http://www.scqf.org.uk/
[3] http://www.e-skills.com/

3 Programmes

Range and levels

Almost all of the 43 colleges include computing programmes in their portfolio of provision. These programmes cover a wide range of computing and related subject specialisms and are validated by a number of awarding bodies and commercial vendors. The predominant awarding body is SQA, although a few colleges offer programmes that include qualifications awarded by City & Guilds and other UK awarding bodies. Increasingly, the content of courses validated by SQA is aligned with the occupational standards of *e-Skills UK*. Subject specialisms include:

- software development;
- technical support;
- networking and internetworking;
- technician studies;
- information technology;
- web design;
- multimedia; and
- games development.

Qualification levels range from SCQF level 4, for example SQA Intermediate 1 courses, to SCQF level 8, SQA Higher National Diploma (HND). Most colleges offering Higher National Certificate (HNC) and HND programmes have clear arrangements with specific HEIs to enable successful learners to progress to the later years of relevant degree courses.

The qualifications landscape upon which college programmes are built has been in a state of flux and development for some time. Two forces have moulded this landscape: the constantly changing technology on which computing is founded; and the restructuring by SQA of its FE provision up to SCQF level 6. At higher education (HE) level, development has been more complex as a result of SQA's piloting of new design rules for Higher National qualifications. Future curriculum developments for college qualifications will take into account the skills and knowledge of computing science acquired by young people in the context of *Curriculum for Excellence*.

Computing has been one of the fastest-changing curriculum areas in recent years. There has been a move from desktop applications running in single-user operating systems to web-based applications running in a browser, and, increasingly, linked to a remote server. Multimedia and web development skills have become essential for application developers. Mobile computing has become widespread and new programming techniques have evolved to enable

mobile applications to be developed. The fastest-selling operating system at the time of writing this report is one embedded in a mobile phone. Converging technologies have brought together disparate applications in small handheld devices.

All of these developments have impinged on what is taught in colleges. As noted previously SQA has, in recent years, restructured its FE provision around a National Certificate (NC) of 12 credits. The *Digital Media Computing* course, at SCQF levels 4-6, brings SQA's suite of FE courses up to date. In many colleges, it has become the main feature of full-time FE programmes. Of particular note is the delivery, in one college, of the full suite of NC courses from levels 4-6, with full-time FE programmes lasting from one to three years. In addition, SQA has validated a number of shorter courses, under the title of National Progression Awards (NPA), typically of three credits each, in such areas as:

- Internet Technology (SCQF 4 and 5);
- Web Design Fundamentals (SCQF 5);
- Digital Media Basics (SCQF 4);
- Digital Media Editing (SCQF 5);
- Digital Media Animation (SCQF 5);
- Software Development (SCQF 4);
- Social Software (SCQF 4);
- Website Development (SCQF 5);
- Computer Hardware & Software (SCQF 5);
- Digital Photography (SCQF 5); and
- Digital Media Production (SCQF Level 6).

The NC courses provide a clear progression path for learners with a broad range of prior learning and experience, and study of the SCQF level 6 course is an appropriate preparation for further study at higher education level. However, few colleges offer a level 6 programme.

The NPAs complement very well the larger NC courses, and enable colleges to devise full-time FE programmes that include an NC and one or two NPAs. This arrangement provides flexibility for colleges in devising FE programmes to meet local needs. In planning their FE provision in computing, most colleges make arrangements for all of the content of their full-time programmes to be assessed for external award.

Typical programme designs include credits made up of:

- discrete, externally awarded units not forming part of any NC or NPA;
- NC course plus six externally awarded units not forming part of any NPA; or
- NC course plus one or more NPAs.

However, so far, only a few colleges have incorporated NPA courses into their full-time provision. Most have chosen stand-alone units to make up the full-time programme.

Guidance provided by the Scottish Funding Council (SFC) on student activity that can be counted towards fundable activity is clearly set out in circular SFC/38/2008[4]. It is for colleges to consider how best to design their full-time FE computing programmes to provide for learners:

- an appropriate vocational education;
- opportunities to develop core, employability and personal skills;
- access to recognition or certification of achievement and attainment; and
- preparation for study at a higher level.

The section on guidance and support in this report gives more details of how full-time FE programmes might incorporate appropriate levels of support for learning through careful programme design.

HND courses have for many years been the main SQA vehicle for the delivery and development of skills at HE level. These skills are of direct relevance to those learners seeking employment at technician level. Employers now send significantly fewer of their staff to study for HNC Computing or other HNC courses on a day-release basis. The overwhelming mode of delivery for HNC and HND courses is full-time.

In recent years, the range of HNC and HND qualifications awarded by SQA has widened to include many of the skills in demand by employers. These skills relate to multimedia and web development and, increasingly, there is synergy between the skills developed in computing courses and those developed through the medium of graphic design. However, collaboration between computing and art and design departments is evident in only very few colleges.

[4] http://www.sfc.ac.uk/information/info_circulars/sfc/2008/circulars_2008.html

3

The range of SQA HNC and HND courses includes a number of themed courses.

- software development;
- technical support;
- computer networking and internetworking;
- interactive media;
- games development; and
- information technology.

This suite of themes reflects well the wide range of occupational areas in the computing sector. SQA and other awarding bodies have worked effectively to keep most of their qualifications up to date.

A significant feature of SQA HNC and HND provision is the incorporation of a number of qualifications linked to the training and qualifications products of a number of major computing organisations. These so-called vendor qualifications include products from:

- Microsoft;
- Avid;
- Cisco;
- CompTia;
- IBM;
- Adobe; and
- Oracle.

By agreeing with these organisations common elements of the content of HNC and HND courses, SQA has added significant value to its HNC and HND awards. Learners studying particular units in HNC or HND frameworks are deemed to have covered the content of an appropriate vendor qualification, or part of it, and are thereby able to access the vendor qualification assessments without further study. In many cases, there is also a significant cost saving to learners who do not have to pay separately for a course leading to assessment for a vendor qualification. In a number of cases, for example with the awards from Cisco, HND learners in more than a few colleges can cover the full content for a particular Cisco award (CCNA) and achieve the award within their HND course.

However, the product life cycles of SQA awards and vendor qualifications are not closely synchronised. When either SQA or a vendor refreshes or updates a

qualification, this can lead to mismatch between units of HNC and HND programmes on the one hand and vendor qualifications on the other. SQA has recognised this issue and has work in hand to bring its qualifications into line with vendor qualifications, where appropriate.

All colleges recognise the importance for learners, as well as for the economy of Scotland, of the effective development of a wider range of skills, attributes and attitudes than the purely vocational skills. These are identified under such headings as core and life skills, essential skills, employability and citizenship, analysis and synthesis skills. They are made explicit in *Curriculum for Excellence*. However they are classified, they are central to the general development of learners to enable them to take their place in society as successful learners, confident individuals, responsible citizens and effective contributors. The design of college programmes does not always include opportunities to develop these skills and attitudes. Examples that emerge from the implementation of *Curriculum for Excellence* will provide effective signposts to good practice in this area.

Most colleges also offer Professional Development Awards (PDA) in computing specialisms. These awards are small packages (usually 3 credits) of HN units, and most have been designed to align with vendor awards. While originally intended to meet the needs of part-time and evening learners, for whom a full HNC award was either not appropriate or too demanding, many colleges have embedded PDAs in their HNC/D courses for full-time learners. The PDA in Desktop Support has been a popular offering, leading to the Microsoft Certified Desktop Support Technician vendor award. Other PDAs include IT Service Management, Computer Support, and Systems Administration.

Promotion of programmes and information to learners

All colleges offering computing programmes promote them through their prospectus of courses. Programmes leading to the award of HNC or HND qualifications are clearly identified as leading to that qualification. At FE level, there is a wide range of titles for full-time programmes. Examples include:

- NC Digital Media Computing with Video;
- NQ Digital Media Computing;
- NC Digital Media Computing;
- NQ Information Technology;
- NQ Business Computing;
- Introduction to Interactive Computing;
- Digital Media Computing: Games/Software Development – NQ; and
- Introduction to Digital Media.

3

The titles of many FE programmes in computing do not always convey clearly the content of these programmes. A potential applicant for a place on a computing programme may have some difficulty in comparing programmes from different colleges, using only the programme name, without going in some detail into the text of a college prospectus. Even then, many descriptions of programmes do not set out in sufficient detail the content of the programme to allow comparisons to be made.

Very few, if any, learners who successfully complete an FE programme proceed directly into relevant employment without further study. The normal route into employment requires an HNC or HND. If the prime purpose of the full-time study of computing at FE level is preparation for study at HN level, it may be helpful to applicants if, as in one college, FE programmes are described in prospectuses in terms of their progression to further study.

In FE programmes, college managers point to a confusion in the minds of applicants for places between computing on the one hand and ICT on the other. Helpfully, in the Technology Experiences and Outcomes of *Curriculum for Excellence*, computing has been renamed as computing science. This will help to reinforce the differences between computing (science) and ICT.

This confusion in the minds of applicants between computing and ICT begins in school. SQA National Qualification courses available include:

- Computing Access 2;
- Computing Studies Access 3;
- Computing Studies Intermediate 1;
- Computing Studies Standard Grade;
- Computing Intermediate 2;
- Computing Higher; and
- Computing Advanced Higher.

The Standard Grade and Intermediate courses will be replaced in 2013-14 by new *National* courses, designed to certificate attainment of young people studying under *Curriculum for Excellence*.

The courses at Access and Intermediate 1 levels develop ICT skills in learners. The others also develop these skills but also include topics that are properly within the ambit of computing science. In addition, for a number of years all pupils have developed skills in the ICT area of the 5-14 curriculum. It is no surprise that young people do not distinguish between computing and ICT. There are those who believe that computing is about using ICT. There are

others who think that computing is about being, for example, a programmer, analyst, technician, games developer or systems designer.

There is, therefore, a need for colleges to identify clearly, particularly at FE level, whether programmes are in computing science or in ICT. Many of those FE learners on computing programmes who lose motivation and engagement do so because their expectations of the programme do not match the reality of the content. Learners who think that computing is about use of applications find little interest in the units dealing with systems, programming or mathematics. Those who study at FE level as preparation for a career in computing are often disappointed by the dominance and repetitive nature of applications-based units in their programme. In many cases, this loss of motivation and engagement by learners leads them to withdraw from their programmes, causing lower programme retention figures. Colleges should identify clearly, in their prospectuses and elsewhere, the nature of their programmes so that applicants for places are fully informed about their content and demands and ensure that there is a clear identification of those programmes that prepare learners for a career in computing.

4 Learning and Teaching

The learning process and teaching for effective learning

In most colleges, those learners attending classes are motivated to make progress with their studies and the development of their practical abilities. In almost all cases, this motivation and engagement is promoted and sustained by the positive relationships between learners and teaching staff. In many classes, learners participate well in class discussions or in question and answer sessions. They are keen to work independently on the development of their practical computing abilities, and, for many learners, this is their preferred mode of study. They work most naturally alone at their computer, interacting only occasionally with peers or teaching staff. The disadvantage of this focus on independent work is that many learners do not develop effective skills in working with others or in contributing effectively to the work of teams. Where teaching staff are aware of this issue and adopt appropriate approaches to developing group and team-based activities, learners do gain skills in teamwork. Of those learners who reach the second year of HND study, almost all demonstrate well the broad range of activities and behaviours that will contribute to a successful career in computing.

Almost all teaching staff demonstrate high levels of vocational expertise and subject knowledge. They engage regularly in continuing professional development (CPD) to update their vocational knowledge and expertise. They use this knowledge and expertise effectively in their teaching, drawing appropriately on current issues and technologies to illustrate their teaching points.

The quality of teaching is highly variable both within and across colleges. There are numerous examples of effective teaching. Teaching staff are highly effective when they:

- make learning intentions clear to learners at the start of lessons;
- create opportunities to promote small group work and teamwork; and
- make effective use of formative assessment to judge the success of their teaching approaches before moving on to the next topic.

However, there are also many examples of lessons in which teaching staff have no clear strategy for ensuring learning. There are important weaknesses in many curriculum teams in their approaches to teaching.

Teaching staff are not effective when they:

- judge the attention span of learners poorly, resulting in overlong presentations;
- do not engage all members of the class in discussion and debate;
- organise their teaching around what is to be assessed, rather than what is to be learned;
- place too much reliance on independent learner work based around progressing through a workbook;
- present insufficient challenge to learners capable of progressing beyond the normal level of work of the class; and
- are often too passive in supporting learners, adopting a strategy of responding to learner requests for help, rather than proactively evaluating the extent to which learning or skills development is taking place.

The list of areas for development identified above forms a useful basis for the discussion by curriculum teams of current teaching practice and of how learners' experiences of their programme should be improved.

The range of teaching approaches adopted in the delivery of some vendor qualifications is also narrow in many cases. A common requirement, stipulated by more than a few vendors, is that the vendor's teaching materials are used in the delivery of units leading to accreditation by the vendor. The design of these materials is often linked to an assumed lesson structure. A typical example is of a three-hour 'teach and demonstrate' class followed immediately by a three-hour practical class for learners. In many cases, teaching staff adopt the assumed lesson plan, which results in unimaginative lessons, dominated by slideshow presentations. Teaching staff and curriculum managers do not consider sufficiently how they can introduce the full range of effective learning and teaching approaches in the delivery of vendor qualifications while continuing to meet the requirements of the vendors in relation to delivery.

Much teaching on computing programmes takes place in computer labs. Typically, the lab will contain enough computers to provide one per learner, usually ranged around the walls of the room. In a few colleges, cluster arrangements are in place with computers arranged in groups throughout the lab. In larger computer labs, tables and chairs are provided in the middle of the lab to facilitate activities that do not involve the use of a computer.

The nature of the learning and teaching environment has a significant influence on the range of activities that take place within these environments. Teaching staff are restricted in the range of learning and teaching approaches that they

can deploy when they deliver lessons in computer labs without a central area in which to carry out activities not involving the use of computers. There are other consequences.

- There is often very little space at a computer work station for learners to take notes, lay out materials, or read texts.
- There is an expectation by learners that they will use the computers at which they are seated, even in a theory class in which no computer use is planned by the lecturer.
- Too much activity is based round learners working their way independently through a workbook with minimal intervention by teaching staff.
- The layout of the lab is not conducive to small group work or to peer interaction.
- Some learners are easily distracted from engaging with lesson activities by the temptation to use their computer for purposes irrelevant to the lesson aims.
- Interaction between teaching staff and learners is restricted by the fact that many of the members of the class are seated with their backs to the lecturer.

As a result, in more than a few lessons, the predominant activity is that learners work at their computer with step-by-step instructional materials through which many work in an unreflective and sterile manner. Little deep learning takes place, no personal development results, and teaching staff are largely passive observers of learner activity.

On the other hand, the range of activities undertaken in computer labs with a central or other area equipped with tables and chairs is much wider, and many highly effective discussions and debates are made possible by this configuration of the learning and teaching space.

In much of the past 20 years, there has been rapid growth in the development of a very wide range of tools and resources for programming. Programmers now have access to:

- objects and classes;
- event-driven languages;
- scripting languages;
- visual and forms-based programming;
- HTML and its variants;
- integrated development environments; and
- application programming interfaces for a wide range of mobile devices.

4

There has been a long-standing and healthy debate in Scotland's colleges around how best to develop learners' programming skills and how to interest learners in pursuing programming as a career. Teaching staff see programming as hard to teach and learners see it as difficult to learn. There are few examples of good learning and teaching of programming. Many computing departments do not succeed in sustaining learners' interest in this important skill.

There are many challenges in developing learners' programming skills. A few are set out in the following list.

- The logic of a program derives from complex analysis.
- The importance of correct syntax is at odds with the inclinations of the txtng generation.
- Program development environments are complex.
- Modularity and top-down design require high order skills of analysis and synthesis.
- Debugging programs that don't run, compile or do what they are supposed to do is a high order analytic skill.

The debate referred to above needs now to move forward into consideration of the best ways to develop learners' programming skills in a progressive manner. Programming can justify its place at all levels of computing education. However, the nature of learners' programming experiences should be appropriate to the stage of their learning. For example, it is not appropriate to introduce FE learners to programming through the medium of a complex object-oriented programming language whose development environment is a text editor. A number of principles of good practice in programming education may be identified.

- Theory should underpin practice.
- Analysis and design are important steps that must not be omitted.
- Sequence, selection and iteration are no longer sufficient to encompass the full gamut of programming constructs.
- Practical activities should be based on problem solving in the real world.
- Modular programming techniques promote group work and collaborative activities.
- At the introductory level, forms, events and browser pages are appropriate contexts for skills development.
- Developing programming skills should be fun for learners and teaching staff.

The debate about programming will benefit from a national focus in which all stakeholders can contribute effectively to identifying best practice in the learning and teaching of programming. The computing science experiences and outcomes of *Curriculum for Excellence* provide a good introduction to the principles of good practice in programming identified above. Colleges will be well placed to build on the work begun in schools in this area.

Guidance and support

Most learners on full-time computing programmes in Scotland's colleges make best progress with their studies, attain qualifications, and progress to further study at higher levels when they are supported by the interventions of skilled teaching staff. These interventions take place in a variety of settings, not least of which is the teaching room or computer lab. Most colleges include timetabled classes for guidance in most FE programmes and in many HE programmes, albeit for less than a full academic year.

Many learners, particularly those returning to study after a long break, or those with a poor prior experience of formal education, gain significant benefit from attendance at classes where activities include:

- individual discussions of their progress with their tutor;
- reflection on their learning with a view to enhancing the ways in which they learn;
- development of personal, study and employability skills (skills for learning, life and work);
- use of assessment to identify next steps for learning; and
- opportunities to discuss aspects of programme management.

However, many younger learners do not value timetabled guidance classes. A number of reasons for this lack of motivation can be identified. Guidance is not linked clearly enough to learners' vocational area, and learners attach low value to the development of skills other than practical vocational skills. The programme of timetabled guidance activities is not always cohesive and well planned by staff.

In a few colleges, computing teaching staff who deliver timetabled guidance classes do not attach as much importance to the work they carry out in guidance classes as they do to their work in vocational classes. Teaching staff should consider how best to lead their timetabled classes of guidance and support to ensure that they meet the identified needs of all learners. They should also ensure that learners understand the importance of effective

guidance and support in ensuring success on their programme. Programme teams should make use of personal learning plans or e-portfolios where appropriate to enable learners to reflect on their progress and to plan next steps.

Teaching and other staff provide good support to learners in their vocational studies. Almost all teaching staff respond effectively to individual learners' needs in the classroom or computer lab and provide effective guidance and assistance to enable learners to overcome gaps in their understanding or to develop fully their practical skills. Staff in all colleges identify this aspect of their engagement with learners as vital to success.

Managers of HE computing programmes have little flexibility within their funding to provide timetabled guidance classes. Nonetheless, many colleges manage to provide structured guidance and support for HE learners for part of the college year. The provision of such guidance is very important, especially for learners on HNC programmes. Student retention on HNC programmes is lower than for learners on HND second year programmes. Many colleges are increasingly aware of the need for such support and are making the commitment of resources to provide it.

In more than a few colleges, learners establish and maintain personal learning plans. Many learners, and more than a few teaching staff, do not value these documents or their approach sufficiently to encouraging reflection by learners on their progress. As a result, their effectiveness is limited for those who do not value them. In the light of the benefits to learners on computing programmes in colleges where personal learning plans are used effectively, those colleges in which such plans are not implemented well are missing valuable opportunities to promote the effective engagement of learners in taking forward their own learning.

5 Outcomes and impact

Assessment

Since the establishment in 2002 of the Scottish Government's initiative, *Assessment is for Learning*, with its emphasis on assessment for learning, assessment as learning and assessment of learning[5], there has been a renewed focus, in schools and elsewhere, on the role of assessment in improving learning. Colleges have been very effective in assessment of learning, known more familiarly as summative assessment or assessment for certification, and almost all teaching staff now recognise the importance of assessment for learning and assessment as learning.

Computing staff in colleges recognise assessment as an important tool in ensuring learning. Increasingly, teaching staff in college computing curriculum teams are deploying appropriate assessment techniques to evaluate the effectiveness of their teaching and to give them confidence to move on to new topics. In many of the colleges visited for this task, there was very effective use of questioning techniques to test learners' understanding of the work at hand. Learners need greater support in many cases to use assessment to evaluate for themselves the extent of their learning or skills development.

One of the aspects of assessment as learning that is not well developed in computing classes is the identification to learners by teaching staff of lesson outcomes or learning intentions. When these important elements of lesson planning are made explicit to learners, they are much better equipped to reflect on their learning experience and to evaluate the extent to which they have made progress in their learning or skills development.

There are well-developed arrangements in all colleges to assess learners for certification by awarding bodies. External moderation of arrangements and assessment decisions demonstrates consistently that teaching staff on computing programmes assess learners fairly and in line with awarding body requirements. In good practice, assessments are organised and scheduled to avoid assessment bunching or overload, and most colleges do this well. Most learners are aware of the regulations relating to re-assessment, of submission deadlines and of the conditions under which assessments are undertaken. Not all learners submit assessments by due deadlines. Teaching staff do not always ensure that learners understand fully the importance of assessment deadlines, not only in relation to timeous submission, but also as evidence of effective time management as an employability skill. The ability to meet deadlines is also important for college learners hoping to progress to further

[5] Details may be found at http://www.ltscotland.org.uk/assess/index.asp

study at certain HEIs, where there are severe penalties for learners who miss deadlines for assessment submissions.

Although curriculum teams manage assessment loads and schedules well, there remains a heavy burden of assessment on learners, particularly those on HE programmes. In a few computing programmes, staff have combined and integrated assessments, either within or across units of study. This holistic approach to assessment has learning and teaching benefits in relation to the integration of computing topics across units and serves also to lessen the assessment burden on learners.

Feedback to learners on their assessed work is an important part of the learning process.

There is an unfortunate tendency on the part of many teaching staff to describe units of study to learners in terms of the summative assessments to be completed rather than the learning or skills to be developed. This leads to a focus on certification rather than on learning, and to an approach to teaching designed to provide evidence for assessment rather than an approach based on ensuring effective learning and skills acquisition. Many teaching staff are more concerned to ensure that learners can demonstrate learning or skills at the time of assessment, than to ensure that learning and skills are thoroughly overtaken and not forgotten soon after assessment. If learning and skills are effectively developed, summative assessment becomes no more than the affirmation of effective learning.

Retention and attainment trends

Nationally collated data on college enrolments, retention and attainment, available from SQA and SFC, provide a picture of performance across all colleges offering computing programmes. SQA data on candidates and awards is reported on a rolling basis from year to year. Candidate registration data in any year relates to the number of candidates registering in that year. Award data for any year relates to the number of awards in that year, irrespective of the year of registration. Thus there is no correlation between candidates and awards for any year. This leads to apparent anomalies where the number of awards in any year may exceed the number of candidate registrations. SFC data is very comprehensive and includes statistics for the broad superclass of computing and ICT. For the purpose of this report, only data on computing programmes is relevant. As almost all ICT programmes in this superclass are part-time, and almost no computing programmes are part-time, these statistics have been ignored and the table below summarises data from full-time

programmes over a three year period. It should be noted that the data for 2007-08 is provisional.

Computing programmes								
Summary of data over three years								
Mode	**Level**	**Enrolled**	**Funded**	**Completed**	**Successful**	**Retention**	**Completion**	**Attainment**
2005/06								
FT	FE	2,970	2,540	1,421	1,299	86%	56%	91%
FT	HE	3,740	3,326	1,947	1,252	89%	59%	64%
2006/07								
FT	FE	2,808	2,372	1,822	1,348	84%	77%	74%
FT	HE	3,626	3,232	2,639	1,945	89%	82%	74%
2007/08 provisional data								
FT	FE	1,949	1,644	1,228	913	84%	75%	74%
FT	HE	1,141	994	844	612	87%	85%	73%

The trend in enrolments over the period 2005-2007 is downwards, both in FE and HE programmes. Retention of learners is fairly consistent over the three years at around 85% for FE programmes and 89% for HE programmes. There is room for improvement in FE programmes. Of those learners retained on their programmes, completion rates in 2005-06 were very low but improved in 2006-08.

Attainment figures are expressed as the ratio of successful learners over those who completed the programme. With the exception of 2005-06, attainment rates have been fairly constant at around 74%. However, if attainment is expressed as the ratio of those learners who passed the funding date[6], the data looks less healthy. The table below shows this recalculation. It demonstrates that, over the three years of data available, fewer than two thirds of learners who were still attending their programme beyond the date for funding attained their qualification. In 2007-08, just over half of learners who were funded on full-time FE programmes gained their qualification.

[6] Those attending after 25% of the programme has elapsed

Computing programmes						
	Mode	**Level**	**Enrolled**	**Funded**	**Successful**	**Attainment based on those passing funding date**
2005/06						
	FT	FE	2,970	2,540	1,299	51%
	FT	HE	3,740	3,326	1,252	38%
2006/07						
	FT	FE	2,808	2,372	1,348	57%
	FT	HE	3,626	3,232	1,945	60%
2007/08 provisional data						
	FT	FE	1,949	1,644	913	56%
	FT	HE	1,141	994	612	62%

At the individual programme level, there is little pattern. Programmes that are very successful in one college have poor completion and attainment in others.

Learners on a number of programmes have good opportunities to achieve more widely and to have that achievement recognised. At FE level, many learner groups are active in their local community or with local charities and use their computing skills well in such activities as developing websites or producing posters for community clients. Many programme teams offer learners teambuilding activities at induction, usually in the form of outdoor projects designed to promote the skills of problem solving and working with others. At HE level, learners achieve more widely through study for vendor qualifications and many attain qualifications that recognise this wider achievement. The possession of one or more of these vendor qualifications increases significantly the employability of learners and makes them very attractive to employers.

Progression and articulation

Very few successful FE learners proceed directly to computing-related employment at the end of their programme. These programmes are designed as preparation for further study at HE level. No national statistics on first destination of successful learners are available. Most colleges report that up

to 50% of their successful FE learners (and more in a few colleges) progress to further study of computing at HE level. Colleges report anecdotally that most successful HE learners progress to computing-related employment or self-employment, or continue their studies at degree level. Most colleges have progression agreements, either formal or informal, to enable successful HNC and HND learners to progress to degree-level study with advanced standing, into either year two or year three of undergraduate programmes. Many successful college learners benefit from these arrangements. Those who continue their studies at an HEI report that their college learning experience has prepared them particularly well for further study at undergraduate SCQF level 9.

In a report prepared by the University of the West of Scotland[7], computing science is identified as the fifth most popular undergraduate programme in 2008 chosen by learners from colleges in the south and west of Scotland. Of the 2610 students in all HEIs who came from colleges, 272 took up places in computing science. Data from previous years is not available for comparison.

[7] Planning & Management Information Services, UWS. 15.04.2009

6 Enhancement through self-evaluation and internal

In recent years, all colleges have made significant progress in the use of self-evaluation as a tool for quality enhancement and improvement. Computing curriculum teams have contributed to that progress, and self-evaluation is embedded in all internal review arrangements to report on the quality of provision, identify areas for development and implement actions for enhancement and improvement. There are examples from all colleges and in many aspects of provision where improvements and enhancements have been implemented in computing programmes. Of particular note is the improved use of data relating to learner retention and attainment for the purposes of identifying provision where retention or attainment are particularly high or low. This improved use of data results in targeted actions to address issues arising from analysis of the data.

However, in relation to quality assurance and improvement in learning and teaching, further progress needs to take place. All computing curriculum teams' self-evaluation reports include a section on learning and teaching. There are evaluative statements in these sections but in many cases, these statements are about aspects of programmes other than learning and teaching. For example, references are often made to the availability of appropriate software to support a programme. These references are more to do with the resources themselves, rather than the impact that their absence is having on learners' experiences. Similarly, almost all self-evaluation reports or annual course reports identify as a strength under learning and teaching that all staff are well qualified teachers and vocationally up to date. This is a strength in relation to staffing but does not provide an evaluation of the use to which teaching staff put their qualifications and expertise in the learning and teaching process. In many colleges poor self-evaluation of learning and teaching does not identify strengths or areas for development, with the result that few improvements in learners' experiences are identified or implemented.

Almost all computing programme teams have an elected learner representative as a member of the team. The effectiveness of learner team members varies across colleges. In some colleges, learners raise issues of quality improvement and enhancement informally. In others, there is little learner engagement in quality enhancement beyond learner representatives attending formal course team meetings.

7 Recommendations

Programmes

In the light of poor attainment by learners on full-time HE courses in recent years, colleges should review their FE portfolio with a view to incorporating level 6 courses as preparation for study at HE level.

Curriculum teams should ensure that sufficient attention is given to the development in their learners of core and life skills, essential skills, employability and citizenship, analysis and synthesis skills.

In designing their FE provision, programme teams should take good account of the skills and knowledge that learners may have acquired in school under the computing science experiences and outcomes of *Curriculum for Excellence*.

Learning and teaching

Curriculum teams should give priority to improving learning and teaching by addressing the areas for development identified in this report.

Teaching staff and curriculum managers should consider how they can introduce the full range of effective learning and teaching approaches in the delivery of vendor qualifications while continuing to meet the requirements of the vendors in relation to delivery.

Curriculum teams should implement appropriate strategies to develop learners' programming skills at all levels.

College curriculum managers should ensure that their timetabled programmes of guidance and support meet the identified needs of all learners. They should also ensure that learners are fully informed of, and understand, the importance of effective guidance and support in ensuring success on their programme. The use of personal learning plans or e-portfolios to enable learners to reflect on their progress and to plan next steps should be considered.

Outcomes and impact

All teaching staff should develop their use of techniques of formative assessment to ensure effective learning and skills development.

Teaching staff should make explicit the learning intentions or outcomes of their lessons to enable learners to evaluate the extent of their learning.

Teaching staff should ensure that learners understand fully the importance of assessment deadlines, not only in relation to timeous submission, but also as evidence of effective time management as an employability skill.

Teaching staff should develop approaches which ensure effective learning and skills development so that summative assessment serves the purposes of learning and teaching.

Computing curriculum teams in each college should continue to analyse their own data to identify poorly performing programmes and implement measures to improve attainment.

Enhancement through self-evaluation and internal review

Curriculum teams should ensure that evaluation of learning and teaching focuses on the practice of teaching staff and of learners, and that appropriate CPD is in place to enable improvement and enhancement of learning and teaching.

8 Excellent practice

Support for learners

In Adam Smith College, curriculum managers have embedded support for learners fully into full-time FE programmes. They have done this by introducing *scaffolding* classes to support delivery of the NC courses. These scaffolding classes are a significant part of the programme design at SCQF level 4, and decrease in significance at level 5, until, at level 6, there is very little scaffolding formally timetabled. The purpose of these classes is to provide extra teaching or support for topics whose outcomes staff know to be difficult for learners. Support is more extensive at level 4 than at level 6 and learners welcome the extra time available to complete coursework or to develop their practical abilities.

Personal learning and development workers

Ayr College has introduced personal learning and development workers (PLDWs) for FE groups and has agreed with teaching staff their purpose and the intended outcomes of their activities. At the time of inspectors' first visit to the college, the system had not been in place for long enough for the intended benefits to be apparent for learners on computing programmes but, by the time of inspectors' second visit to the college, the positive contribution of PLDWs to guidance and support had been realised. Retention has improved and learners benefit from more speedy resolution of any personal difficulties or learning support needs.

Appendix

Colleges visited in the preparation of this report

Adam Smith College
Anniesland College
Ayr College
Borders College
Coatbridge College
John Wheatley College
Lews Castle College
Motherwell College
Stevenson College Edinburgh
Stow College